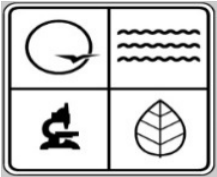
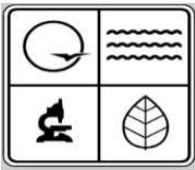


## PERFORMANCE EVALUATION - Anemometer Orientation

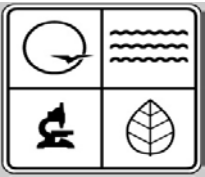
SITE NAME: Ameren Valley APCP Installation ID: 071-0003 Parameter: <b>WD</b> Monitor Type: 10m Dispersion		AUDITOR: D. Malorin AUDIT DATE: 4/21/2015 SITE OPERATOR: D. Cummings ORGANIZATION: Enviroplan
<b><u>INSTRUMENT</u></b> ANEMOMETER MODEL: Climatronics model F-460 vane SERIAL NUMBER: <b>N2310C (vane only)</b>	<b><u>REFERENCE STANDARD METHOD</u></b> Compass Model: Suunto KB-14/360R G Serial Number: 14142737	
AQS LATITUDE: 40.0272 N AQS LONGITUDE: 95.2358 W (Units are Decimal Degrees) <b>NOAA DECLINATION 0.84 W</b> SOURCE: WWW.NGDC.NOAA.GOV		
METHOD: Anemometer orientation is determined with a magnetic compass on a tripod. An orientation rod is mounted on the tower. The compass is then aligned with the rod. The magnetic site variation for this method and site is determined by NOAA-NGDC for the given date. If NOAA declination is 20 E, the magnetic compass needle will point 20 to the East of true map North. To calculate the expected MAP (True) North compass value, subtract 20 from 360. For a West declination, add the deviation to 360, to get the expected map north value at the site.		
Expected compass reading indicating MAP (true) North:		<b>360.8</b>
<b>ORIENTATION EVALUATION:</b>		
Site compass reading:	<b>358.5</b>	degrees
<b>Orientation error:</b>	<b>-2.3</b>	degrees
<b>Total System error:</b>	<b>-1.1</b>	MQO Limit is +/- 5.0 degrees total system error.
*From instrument WD audit Instrument error: 1.2		
SOURCE: QA Handbook Volume IV (2008) and MMGRMA EPA-454/R-99-005 (FEB 2000)		
Instrument within design specifications?	YES	<b>VSR Issued?</b>
Adjustment needed?	NO	Post-adjustment compass reading:
COMMENTS: Declination uncertainty is +/- 0.36 degrees. QC error was -1.0 degrees.		

W	E	1
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## PERFORMANCE EVALUATION - Anemometer -Wind Speed - Wind Direction

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	<b>WS-WD</b>		SITE OPERATOR:	D. Cummings
Monitor Type:	10m Dispersion		ORGANIZATION:	Enviroplan
<b><u>INSTRUMENT</u></b>			<b><u>REFERENCE STANDARDS</u></b>	
ANEMOMETER MODEL: Climatronics F-460 system WD - Vane - model 100076 WS (horizontal) - cups - model 100075 WS (vertical) -propeller- model 102236  SERIAL NUMBER: <b>N2310C / P12197 / N2289C</b>			Vane Angle Bench:     crossarm visual alignment  Cup/Prop Speed:       RMY 18802 synchronous motor	
<b>WIND DIRECTION SENSOR EVALUATION</b>				
Vane Sensor	<b>Direction</b>	<b>Reference</b>	<b>DL Response</b>	
Linearity	North	0.0	1.2	
	East	90.0	92.6	
	South	180.0	182.7	
	West	270.0	271.4	
MQO is +/- 3.0 degrees.				
<b>WIND SPEED SENSOR EVALUATION</b>				
Horizontal Sensor	RPM	<b>Reference (m/s)</b>	<b>DL Response</b>	
Calibration Verification	200	4.84	4.8	
	300	7.19	7.3	
	600	14.25	14.4	
	900	21.31	21.3	
MQO: +/- 0.2 m/s				
<b>WIND SPEED SENSOR EVALUATION</b>				
Vertical Sensor	RPM	<b>Reference (m/s)</b>	<b>CW DL Response</b>	<b>CCW DL Resp</b>
Calibration Verification	200	1.25	na	na
	300	1.88	1.92	-1.86
	600	3.75	3.78	-3.72
	900	5.63	5.67	-5.60
MQO: +/- 0.2 m/s				
<b>WIND DIRECTION TOTAL SYSTEM ERROR EVALUATION:</b>				
Instrument error:	<b>1.2</b>	degrees	<b>*From vane alignment audit</b>	
Total System error:	<b>-1.1</b>		Orientation error:	<b>-2.3</b>
MQO is +/- 5.0 degrees total system error.				
MQO SOURCE: QA Handbook Volume IV (2008) / MMGRMA "EPA-454/R-99-005" (FEB 2000)				
Instrument within design specifications?	YES	<b>VSR Issued?</b>	<b>NO</b>	
COMMENTS:				

## PERFORMANCE EVALUATION - Ambient Temperature and Temperature Difference

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Ambient Temperature		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

### **TEMPERATURE REFERENCE STANDARD**

Model: Fisher Scientific Traceable Digital ( immersed in water bath )

Serial Number: 230040377 and 61457725

### **2-Meter Station Temperature Sensor**

Serial Number: P11360

Model / Type: Climatronics model 100093 mounted in a TS-10 motor-aspirated shield  
(the model 100093 consists of a thermistor bead encased in a vinyl sheath)

### **10-Meter Station Temperature Sensor**

Serial Number: P10913

Model / Type: Climatronics model 100093 mounted in a TS-10 motor-aspirated shield  
(the model 100093 consists of a thermistor bead encased in a vinyl sheath)

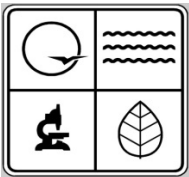
Low Temperature ( 0 °C )	2-Meter Probe:	0.3	$\Delta T$ MQO: +/- 0.1 °C MQO: +/- 0.5 °C
	10-Meter Probe:	0.3	
	Reference Standard:	0.2	
"Ambient" Temperature ( 20 °C )	2-Meter Probe:	23.3	$\Delta T$ MQO: +/- 0.1 °C MQO: +/- 0.5 °C
	10-Meter Probe:	23.4	
	Reference Standard:	23.3	
High Temperature ( 40 °C )	2-Meter Probe:	38.8	$\Delta T$ MQO: +/- 0.1 °C MQO: +/- 0.5 °C
	10-Meter Probe:	38.8	
	Reference Standard:	38.5	

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

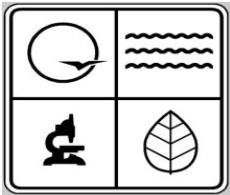
Instruments within design specifications?	YES	VSR Issued?	NO
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COMMENTS: Aspirator motor current draw is monitored by the datalogger.

## PERFORMANCE EVALUATION - PRECIPITATION

SITE NAME: Ameren Valley Installation ID: 071-0003 Parameter: Precipitation Monitor Type: Dispersion Modeling		AUDITOR: D. Malorin AUDIT DATE: 4/21/2015 SITE OPERATOR: D. Cummings ORGANIZATION: Enviroplan					
<b>INSTRUMENT</b> MODEL: Climatronics model 100097 Heated Tipping Bucket Rain Gauge (8-inch collector) SERIAL NUMBER: <b>N15508</b>	<b>REFERENCE STANDARDS</b> Fluid Volume: 100 mL glass buret Pyrex - Class B - graduated 0.2 mL *Verified with Mettler Balance						
<b>PRECIPITATION MEASUREMENT AUDIT</b>							
Inlet Diameter (mm): $A = \pi r^2$	<table border="1"> <tr><td>203.2</td></tr> <tr><td>32429</td></tr> <tr><td>8.2</td></tr> <tr><td>0.01</td></tr> <tr><td>0.254</td></tr> </table>	203.2	32429	8.2	0.01	0.254	= 8.0 inches $\text{mm}^2$ x counts = in / hr
203.2							
32429							
8.2							
0.01							
0.254							
Tipping Bucket Volume (milli-Liters per tip)		Ambient Temperature					
Resolution (inches of rainfall per tip)		20.0 °C					
Resolution (mm of rainfall per tip)		Ambient Pressure					
		744 mmHg					
<b>INPUT</b>							
Reference Input Volume (mL):	TEST 1	TEST 2					
Calculated rainfall input (inches):	101.0	99.0					
Calculated rainfall input (mm):	0.123	0.120					
	3.11	3.05					
		TEST 3					
		99.5					
		0.121					
		3.07					
<b>Instrument Response</b>							
Reported channel value (inches per hour):	0.12	0.12					
Audit Difference in units (inches per hour):	-0.003	0.000					
Audit Δ% Difference (of input volume):	-0.1%	0.0%					
<b>MQO Δ%: +/- 10%</b> Source: EPA QA Handbook Vol. IV (2008) and MMGRMA "EPA-454/R-99-005" (2000)							
<b>CONDITION OF RAIN GAUGE (Catchment basin and internal component area):</b>							
Gauge Rim Level? Tipping Bucket Level?	YES	Calibration Date: 4/18/2015					
Instrument within design specifications?	YES	<b>VSR Issued?</b> NO					
<b>COMMENTS:</b> Response is from 1-minute increments. Audited at datalogger time 1300 to 1400.							

## PERFORMANCE EVALUATION - SOLAR RADIATION

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Solar Radiation		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

### SOLAR RADIATION REFERENCE STANDARD

Serial Number: **LM2-4412 / PY86242**

Model: LI-COR LI-250A / LI-200SA (Portable Indicator and Sensor)

\*Referenced in AUG 2013 to Eppley Precision Spectral Pyranometer by manufacturer.

Calibration Factor: -10.43 ( Watts / m<sup>2</sup> ) per micro-amp

### STATION SOLAR RADIATION SENSOR

Serial Number: **37412**

Model / Type: Eppley 8-48 Pyranometer

The model 8-48 meets most of the ISO 9060 First Class Specifications but is officially designated as a Second Class Pyranometer for Global Solar Radiation measurements.

Calibration Factor: Transfer function is  $8.57 \times 10^{-6}$  Volts per Watts / m<sup>2</sup> or  $\mu\text{V}/(\text{W}/\text{m}^2)$

(sensor is mounted at approximately 2 meters, on a separate post, east of 10m tower)

Reference Standard (Watts / meter squared):

**834**

Station Sensor (Watts / meter squared):

**824**

Difference (W/m<sup>2</sup>):

**-10.0**

**-1.2%**

MQO for station Solar Radiation versus reference standard is **+/- 5 % Δ**.

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

Instruments within design specifications?

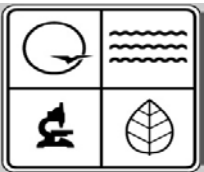
**YES**

**VSR Issued?**

**NO**

COMMENTS: Measurements taken at midday during periods of unobstructed daylight.

## PERFORMANCE EVALUATION - Relative Humidity

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Relative Humidity		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

### RELATIVE HUMIDITY REFERENCE STANDARD

Serial Number: 60975030 / 61031996  
Model: Rotronic Hygro HP22-A / HC2-S (in multi-plate radiation shield)  
(Humidity and Temperature Indicator-Probe)

### **Station Relative Humidity Sensor**

Serial Number: P10993  
Model / Type: Climatronics model 102273  
(sensor is mounted at 2 meters inside naturally-aspirated solar radiation shield)

### **Relative Humidity Evaluation**

Reference Standard ( % RH ):

26.7

Reference Temp:

21.0 °C

Station Sensor ( % RH ):

29.3

Difference ( % RH ):

2.6

MQO for station relative humidity versus reference standard is +/- 7 % RH.

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

Instruments within design specifications?

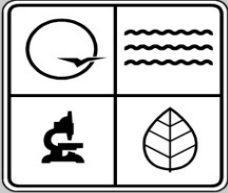
YES

VSR Issued?

NO

COMMENTS:

## PERFORMANCE EVALUATION - Barometric Pressure

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Barometric Pressure		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

### **BAROMETRIC PRESSURE REFERENCE STANDARD**

Serial Number: 74001263  
Model: Druck DPI 740 - Digital Pressure Indicator  
(Referenced to a Princo Fortin 453 NWS-type Mercury barometer)

### **Station Barometric Pressure Sensor**

Serial Number: N15783  
Model / Type: Climatronics model 102663  
(sensor is mounted at 2 meters on tower inside weather-proof sensor enclosure)

Reference Standard (mmHg):

**745.0**

**993.3**

millibars

Station Sensor (mmHg):

**739.6**

**986.0**

millibars

Difference (mmHg):

**-5.4**

MQO for Station barometric pressure versus reference pressure standard is +/- 2.3 mmHg (3 millibars).

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

Instruments within design specifications?

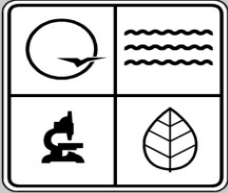
**NO**

**VSR Issued?**

**NO**

COMMENTS: Alternate QA device DPI-705 read 994.2 millibars. QC device read 992 mb.  
Instrument ground problem was located and fixed. Instrument was re-evaluated.

## PERFORMANCE EVALUATION - Barometric Pressure

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Barometric Pressure		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

### **BAROMETRIC PRESSURE REFERENCE STANDARD**

Serial Number: 74001263  
Model: Druck DPI 740 - Digital Pressure Indicator  
(Referenced to a Princo Fortin 453 NWS-type Mercury barometer)

### **Station Barometric Pressure Sensor**

Serial Number: N15783  
Model / Type: Climatronics model 102663  
(sensor is mounted at 2 meters on tower inside weather-proof sensor enclosure)

Reference Standard (mmHg):

743.8

991.7

millibars

Station Sensor (mmHg):

744.1

992.0

millibars

Difference (mmHg):

0.3

MQO for Station barometric pressure versus reference pressure standard is +/- 2.3 mmHg (3 millibars).

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

Instruments within design specifications?

YES

**VSR Issued?**

**NO**

COMMENTS: Alternate QA device DPI-705 read 992.9 millibars. QC device read 992.1 mb.